

APPENDIX E

PREDICTIVE MODELING FOR RADIONUCLIDE LOADING ON OAK RIDGE RESERVATION BIOSOLIDS LAND APPLICATION SITES

**PREDICTIVE LIFETIME RADIONUCLIDE
MODELING FOR
THE OAK RIDGE RESERVATION BIOSOLIDS
LAND APPLICATION SITES**

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INTRODUCTION

The City of Oak Ridge owns and operates a Publicly Owned Treatment Works (POTW) at which wastewaters from a variety of residential and industrial users connected to the sanitary sewer system. Solids that settle and are created as a result of wastewater treatment are known as sludges or biosolids. These materials can be in a liquid or solid phase and can be applied to approved areas as a fertilizer soil-amendment due to its nitrogen rich content. Biosolids are classified according to pathogenic organism (i.e., disease-causing) content. Class B contains very few pathogens that are typically destroyed within the first hour after surface application. Class B biosolids must have permitted areas and use established EPA management practices such as no application in wetlands or floodplains, minimization of contact with members of the general public for specific time periods after application, etc. to minimize negative consequences involving Class B biosolids. Class A biosolids have no pathogens and thus, do not require permits. Class A materials can be freely distributed without EPA management practices required for Class B materials.

Biosolids also contain trace quantities of contaminants such as heavy metals, organic compounds and radionuclides. Presently, only heavy metals have specific limits that must be maintained in order to land-apply biosolids. Organic compounds and radionuclides do not have regulatory limits established by the Tennessee Department of Environment and Conservation (TDEC) or U. S. EPA.

The city land-applies biosolids produced at their POTW on six (6) TDEC-approved, EPA-permitted application sites on the Oak Ridge Reservation (ORR). These sites account for a total of 133 ha (329 acres) on the ORR. At the present time, the city applies liquid Class B (i.e., low pathogen content) at approximately 2% solids (i.e., 98% water) via pressurized spray that extends 30 to 40 feet to the left of the application vehicle. In the Summer of 2001, the city will convert their biosolids management process to produce solid Class A (i.e., no pathogens) material at a 50 - 60% solids content.

Predictive Models

In 1996, DOE Oak Ridge Operations (DOE-ORO) completed an Environmental Assessment (EA) which established radionuclide limits for both biosolids and land application site soils. Because of limited radionuclide capacity, the City of Oak Ridge requested the dose-based radionuclide limits for application sites to be increased from 4 to 10 mrem/yr. In November 1999, TDEC Division of Radiological Health responded with a concurrence letter authorizing the increase. As a result, a new EA has been prepared by DOE that assesses all environmental impacts from the proposed increase.

Predictive models were developed for the sole purpose of aiding in the assessment of application site soils and the radionuclide levels each site would attain at the end of operational life. The results and assumptions used for the predictive models in this document reflect the following criteria:

- 50 tons/acre lifetime loading for each ORR land application site
- 15 centimeter soil mixing depth with land applied biosolids
- Existing (SAIC 1996) and proposed (Performance Technology Group 2001) radionuclide limits developed specifically for ORR land application sites
- Average radionuclide levels observed in the City of Oak Ridge Sewer System since 1988
- Calculated radionuclide loading levels for application site soils as of 12/31/00
- Uniform application of biosolids materials to each land application site

Summary of Results

The results of the predictive modeling for the ORR biosolids land application sites demonstrate that the Rogers Site would attain the greatest percentage of the existing and proposed application site radionuclide loading limits. The level attained is 56.8% of the existing 4 mrem/yr limit (DOE 1996) and 20.1% of the 10 mrem/yr limit proposed in the current EA (DOE 2001). Modeling results summaries are listed in *Table E.1*.

Table E.1 ORR Biosolids Land Application Site Radionuclide Predictive Model Results

Land Application Site	Projected Total Sum of Radionuclide Fractions for Site Soil (4 mrem/yr)	Projected Total Sum of Radionuclide Fractions for Site Soil (10 mrem/yr)
Upper Hayfield #1	0.409	0.150
Upper Hayfield #2	0.393	0.145
High Pasture	0.492	0.182
Rogers Site	0.568	0.201
Watson Road	0.513	0.190
Scarboro Road	0.453	0.167

References

Environmental Assessment of The Proposed Changes to The Land Application of Sanitary Sludge on the Oak Ridge Reservation. Prepared by U.S. Department of Energy, Oak Ridge Operations Office, Waste Management and Technology Development Division. November 1996.

Environmental Assessment of The Proposed Changes to The Land Application of Sanitary Biosolids on the Oak Ridge Reservation. Prepared by U.S. Department of Energy, Oak Ridge Operations Office, Environmental Management. August 2001.